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The development of the sporogonium and adjacent tissues of the gametophore of Conocephalum conicum*

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(WITH PLATES 30–33)

Although several rather extensive articles on the morphology and development of the liverwort *Conocephalum conicum*† have appeared, there are certain interesting and important features of this plant that do not seem, as yet, to have been described. This investigation was undertaken for the purpose of tracing the development of the sporogonium and the surrounding tissue of the gametophore in order to determine the origin of a sheath which surrounds and encloses the calyptra and to see if it bears any relation to the pseudoperianth long known to exist in the related genera *Marchantia* and *Preissia* but said to be lacking in *Conocephalum*. This seemed especially desirable, since the two most recent and important articles ‡ dealing with this plant do not touch upon this interesting structure.

* *Conocephalum conicum* (L.) Dum. (*Fegatella conica* of most European authors) is one of the larger Marchantiaceae. It is widely distributed in Europe and North America. It grows abundantly in the ravines near Ithaca, N. Y., on moist or dripping rocks. The original post-Linnaean spelling of the generic name appears to be *Conocephalum* Wigg. Prim. Fl. Hol. 82. 1780, though Dumortier and some others have used the form *Conocephalus*.

† Contribution from the Department of Botany, Cornell University, No. 136.

‡ Cavers, F. On the structure and biology of *Fegatella conica*. Ann. Bot. **18**: 87–120. *pl. 6, 7*. 1904.

Bolleter, E. *Fegatella conica* (L.) Corda. Eine morphologisch physiologische Monographie. Beih. Bot. Centralb. **18**[1]: 327–408. *pl. 12, 13*. 1905.

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The gametophore of *Conocephalum conicum* begins to develop early in June. The archegonia are ready for fertilization about the first of July. The sporogonia develop rather slowly but the spores and elaters are fully formed by the time winter sets in, when growth ceases. At this time the stalk of the gametophore is very short, so that the conical receptacle appears to be sessile on the thallus. During the warm days of the following May, the stalk of the gametophore elongates with some rapidity, lifting the receptacle high above the surface of the thallus. The stalk of the sporogonium itself then elongates, after which the spores are set free by the rupture of the capsule. *

Each archegonium is developed in a flask-shaped cavity or depression on the under side of the archegoniophore. Usually only one archegonium appears in each depression, but rarely two may be found. The archegonium arises from and is attached to the tissue at the base of the cavity in which it is developed, but the neck of the mature archegonium projects through the circular opening of this depression and curves upward toward the lateral margin of the gametophore (*figure 37*). At the time of fertilization the wall of the venter is about two layers of cells in thickness (*figures 1, 6, 37*).

The fertilized egg enlarges until it nearly or quite fills the oblong cavity of the venter (*figure 1*) and becomes enveloped by

* *Note.* — The first material was put up in May, 1908, when the sporogonia were mature on elongated stalks, and in the beginning of June when there was evidence that the archegoniophores were beginning to develop at the tips of the new thalli. Beginning with July 14, 1908, until August 10, 1908, material collected at Ithaca was carefully packed in moist sphagnum and shipped to New York City where it was kept in a moist vigorously growing condition until it was needed. Collections were made from this material two or three times weekly until September 21, 1908.

All the material used for this work was fixed in chrom-acetic fixing fluid. The gametophores were fixed entire. In all cases care was taken to remove the air from the tissue. For the material put up at Ithaca the large air-pump in the laboratory was used, but for the material fixed elsewhere a small suction pump attachable to a faucet was found as effective as the large air-pump. This treatment of the tissue was necessary for, as is well known, the thalli and gametophores of all the Marchantiaceae contain air which prevents the entrance of fixing fluids as well as other reagents, especially those used in infiltrating and embedding.

All the sections were cut 8–10 μ in thickness, except those of the mature sporogonium containing germinated spores; these were sectioned 5 μ thick. The sections were stained with Delafield's haematoxylin alone or with a counterstain of Bismarck brown.

a deeply staining membrane. The inner surface of the venter is stained intensely (*figures 1, 6, 37*). The nucleus also is stained deeply, its membrane being easily made out, but the cytoplasm is stained diffusely.

The nucleus of the fertilized egg soon divides into two, which usually lie close together (*figures 2, 3, 6, 10*), but in some cases they may be separated (*figure 4*). These nuclei are of approximately equal size. They may be parallel or transverse to the long axis of the archegonium. A cell wall is not laid down immediately after the first division of the nucleus but follows tardily.

The first division wall is transverse and is, as are all the walls when newly formed, a delicate membrane. In order to be certain that no walls were overlooked, Bismarck brown, which is well known to be one of the best counterstains for cell walls, was used. This division is followed by two or three successive transverse divisions forming either four or five cells (*figures 7, 8, 9, 11, 13, 16, 17, 32*). As in the case of the first division, the formation of a wall is always subsequent to the division of the nuclei.

In all the material studied, no longitudinal wall was formed until the tier of four or five cells was completed, although about fifty were seen in approximately this stage (*figures 7, 8, 9, 11, 13, 16, 17, 32*). Considerable attention was given to this sequence in the formation of cell walls, since the method observed is at variance with that usually described for this family and especially for this species by Cavers ('04). This author describes the young embryo as divided into octants by one transverse and two longitudinal walls at right angles to each other. My observations accord more nearly with those of Bolleter ('05), but this author describes and figures only four cells formed by three transverse walls.

The outline of the young embryo differs considerably from that of *Preissia* and *Marchantia*, being elongated parallel to the long axis of the archegonium and broader at the distal than at the proximal end (*figures 11, 12, 16*). In the two plants first mentioned it is nearly spherical.

Figure 12 shows the first longitudinal division at the lower or distal end of the young sporogonium; *figure 24* shows a cross section at this stage; *figure 18* a variation, the only one observed.

This first longitudinal wall is soon followed by a second one at right angles to it, so that each one of the original cells is divided into four. These two longitudinal walls are shown in cross section in *figures 14*, *23*, and *25*.

While the development just described is progressing in the embryo, periclinal division takes place rapidly in the venter of the archegonium, so that the wall is finally four or five layers of cells in thickness, and the whole structure becomes much more massive (*figures 14* and *16*). Moreover, the tissue forming the original stalk of the archegonium increases, and its cells become rich in protoplasm. Because of their deeply staining contents and their smaller size, there is a strong contrast between them and the adjacent tissue of the gametophore (*figure 37*). The whole calyptra is much thicker and more massive than that of *Marchantia* and *Preissia*.

The young sporogonium next increases decidedly in length (*figures 19*, *20*, *22*, *30*) and the elongating proximal end forces its way into the tissue developed from the stalk of the archegonium, from which it derives its nourishment (*figures 16*, *22*, *28*). This elongated more slender proximal portion of the sporogonium is the foot or absorbing organ. It is apparent, therefore, that the foot in *Conocephalum conicum* becomes differentiated much earlier in the life history of the sporophyte than in *Marchantia* or *Preissia*. The mature foot is a conical structure deeply imbedded in the tissue of the gametophyte, while in *Marchantia* and *Preissia* it is very short and broad.

The elongation of the embryo is accompanied by repeated transverse division, so that it becomes a clavate structure, many cells in length (*figures 15*, *26*, *28*, *29*). Some of the original transverse walls appear heavy and prominent at this stage (*figures 15*, *26*, *28*, *29*). It seems certain that one of the original four or five transverse walls formed in the embryo separates the capsule primordium from the stalk and foot portion, but whether this is the first original wall cannot be stated positively. *Figure 29* shows a slightly older stage in which one of the original walls is distinct.

Growth is now more rapid in the distal or capsular portion of the sporogonium. By the formation of periclinal and transverse walls it increases in breadth and massiveness (*figures 21*, *26*, *28*,

29, 31). During the continued growth of the sporogonium both the foot and capsular portion expand, so that a definite constriction appears (*figures 27, 29, 36*). This constricted portion is the part which later gives rise to the stalk.

In the capsular portion cell division soon gives rise to a single superficial layer of cells which is distinguished from the tissue within, in that its cells are larger and less rich in protoplasm and therefore stain less deeply. This superficial layer becomes the wall of the capsule, while the deeply staining inner tissue, the cells of which have now become arranged in longitudinal rows, is the sporogenous tissue (*figures 27, 36, 39*). At this time the sporogonium fills the cavity of the venter, pressing against its wall.

Certain cells of the alternate rows of the sporogenous tissue become larger than those lying between them, are richer in protoplasm, and have larger nuclei. These are the mother-cells of the spores (*figure 47*). *Figure 53* shows a slightly older stage. These enlarged cells are separated from those surrounding them, become rounded and undergo a period of growth, after which each divides into four tetrahedral spores (*figure 46*).

By the time the tetrads are formed the cells that are to form the elaters have elongated considerably as is shown in *figure 48*, but the characteristic elater-form does not appear until after the spores have become mature in the autumn.

The sporogenous tissue in the capsule of *Conocephalum*, *Preissia*, and *Marchantia* is arranged in longitudinal rows. In the two former plants some of the cells in alternate rows enlarge, separate from the adjacent cells, and become the spore mother-cells, each of which divides into four tetrahedral spores. In the last-named plant, the sporogenous cells divide into groups of four or eight cells each, which always retain their identity as groups, each cell of the group ultimately dividing to form four spores. It has long been known that the spores of *Conocephalum conicum* germinate while still within the capsule (*figure 54*). The spores of *Marchantia* and *Preissia* do not germinate until after they have escaped from the capsule.

During the development of the sporogonium prominent changes take place in the surrounding tissue of the gametophyte, so that at the time of its maturity, it is enclosed not only in the calyptra,

but in an additional covering or sheath which lies outside of the calyptra and is derived from the adjacent tissue of the gametophore. This outer sheath does not seem to have been described by any writer on *Conocephalum*, although it was figured in outline by Bolleter (*loc. cit.* 364, *f. A*). This writer makes no reference to this feature, either in the text or in the explanation of his figure. Since no similar organ seems to have been described for any of the other Marchantiaceae, its origin and development will now be considered in detail.

As already pointed out in a previous paragraph, the archegonium of *Conocephalum conicum* is developed in a flask-shaped cavity in the tissue on the under side of the gametophore (*figure 37, 38*). The gametophore of this plant, in common with all other Marchantiaceae, possesses numerous large air-chambers separated by plates of cells. The chambers in the upper part of the gametophore are large and nearly isodiametric. Toward the lateral margin they become smaller and the smallest ones are at the base. The tissue making up the wall of the archegonial cavity on the side toward the stalk of the gametophore is solid at the time of fertilization (*figure 37*), but after this time air-chambers appear in this also (*figure 38*). In the vicinity of the archegonial depression these chambers are long, narrow, and compressed, so that they appear much more slender in longitudinal section than those in the upper part of the gametophore.

At the time of fertilization the archegonial cavity opens to the outside. Through this opening the neck of the archegonium protrudes as has already been stated (*figure 37*). After fertilization the neck of the archegonium withers and turns brown (*figures 34, 38, 40*), as is usual in the bryophytes. Then the lip-cells forming the margin of the opening of the archegonial cavity elongate transversely and grow until those on opposite sides meet and the opening is nearly or quite closed (*figures 40, 44, 45, 52*). As a result of this growth the archegonium with its embryo is contained in a closed cavity.

As the embryo and the calyptra enlarge, the tissue of the gametophore bounding the archegonial cavity on the side adjacent to the stalk of the gametophore elongates rapidly in a vertical direction and since little or no growth takes place on the opposite

side the closed mouth of the archegonial cavity is pushed around toward the outside of the gametophore (*figures 40, 45*). Further growth of the sporogonium and calyptra is accompanied by still further development of the tissue separating the air-chambers adjacent to the stalk, so that at maturity the closed opening is found nearly opposite the foot of the sporogonium on the outer side of the gametophore (*figure 44*). The whole outer enveloping sheath is therefore formed by the elongation of the laminae or plates of cells separating the air-chambers in the wall of the archegonial cavity adjacent to the stalk of the gametophore.

At the time the sporogonium has reached the stage of development shown in *figure 45*, and at the time when the spore mother-cells have separated from one another, it may be observed that its growth has not kept pace with that of the calyptra or the enveloping sheath, so that a considerable space appears between the wall of the sporogonium and the surrounding calyptra. The calyptra and sheath, having no support from within, are infolded or collapsed into this depression. As further development takes place the sporogonium comes to fill this space so that the enveloping calyptra and sheath are tightly stretched about the distal end of the sporogonium (*figures 35, 41*).

That the calyptra and sheath do not form one continuous tissue is clearly shown by the fact that the shriveled neck of the old archegonium is found lying between these two envelopes, sometimes closely squeezed between them (*figures 34, 35, 40 41, 50*). That the outer sheath is made up of plates of cells representing the boundaries between air-chambers is clearly shown in *figures 34, 35, 41, 43, 49*, and *51*. An examination of these figures shows that the tissue of the calyptra is composed of cells closely united while the outer sheath is composed, in longitudinal section, of several rows of cells entirely separated from one another (*figures 34, 35, 41*). It should be mentioned that the apparent continuity of the cell walls of the different plates of the sheath, shown in *figures 49, 50*, and *51*, is due to the overlapping of the cells, because the sections are cut in a slightly oblique direction. The true condition is, however, perfectly apparent in *figures 34, 35, 41, 43*, and *45*.

This outer sheath formed from the tissues of the gametophore

should not be confused with the pseudoperianth such as appears in certain other Marchantiaceae, *e. g.*, in *Marchantia* and *Preissia*. That structure originates as a collar-like outgrowth from the cells immediately beneath the base of the archegonium, which are descendants from the original cell from which the mother-cell of the archegonium was cut off. Only the slightest indication of this organ appears at the time of fertilization, so that it is an entirely new structure which develops after fertilization has taken place. At its maturity it is a tubular sheath, a single layer of cells in thickness and is never closed or continuous around the distal end of the sporogonium. Such a true pseudoperianth does not exist in *Conocephalum conicum*. It is replaced by the sheath which has already been described as being a further development of the walls of the cavity in which the archegonium is developed. It is composed of several distinct laminae, which are morphologically the plates of cells separating the air-chambers on one side of the archegonial cavity and at maturity completely enclosing the sporogonium and calyptra.

The function of this enveloping sheath may possibly be protective. Since the sporogonium rests over winter in the nearly mature condition, this extra covering, with its air spaces, may serve to prevent excessive radiation and transpiration.

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Explanation of plates 30–33

The figures are so freely alluded to in the accompanying text that further explanations would perhaps involve unnecessary repetitions. It should be stated, however, that all the figures were drawn with the aid of a camera lucida. Figures 1–26, 28–33, 46–48, and 51–53 were drawn with a Bausch and Lomb ⅛-inch objective and 1-inch ocular; 27, 36, 37, 39, 42, 49, 50, and 54, with a ⅛-inch objective and 2-inch ocular; 34, 35, 38, 40, 41, and 43, with a ⅔-inch objective and ½-inch ocular; and 44 and 45, with a ⅔-inch objective and 1-inch ocular. The original drawings have been reduced one half.

Notes on the anatomy of Sesban macrocarpa Muhl.*

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(WITH PLATE 34)

Sesban macrocarpa was first described by Muhlenberg in 1818; later, Pursh changed the generic name to *Sesbania*, which form is used by some authors. The species under consideration is the only representative of the genus known in North America, although there are a number in other parts of the world in warm or tropical regions. *Sesban macrocarpa* is one of the annuals which flourish under the conditions that exist in Arizona and the southwest in general, and further south to Central America, although it is known in the eastern section as far north as Pennsylvania. It is placed in the Papilionaceae near *Robinia*, *Astragalus*, etc., in the tribe Galegeae.

Before going into details of the anatomical structure of the plant in question the following review of the anatomical features common to the Papilionaceae will be of interest. The characteristics common to these forms are: † (1) ducts with simple openings, (2) simple pitted wood-prosenchyma, (3) lack of crystal glands, and (4) scarcity of the usual one-celled hairs, (5) ducts filled with brown albuminous substance, (6) hairs which usually consist of one row of cells having one or more short basal cells and one long end-cell, besides (7) excretion of calcium oxalate in the form of staff-like crystals. As the other characteristics are not common to all species, they will not be considered here.

The material used was chiefly raised from seed at the New York Botanical Garden. That from which most of the work was done was fully mature, having flowered. The plants all averaged about the same height, the particular one studied being 105 cm. in length. In order to facilitate orienting the sections, the plant was cut into seven lengths, successively shorter, and the parts were

* Britton, Manual of the flora of the Northern States and Canada, 550.

† Solereder, Anatomie der Dicotyledonen, 288.

mapped out on paper. In this way any section could be cut and its position in the plant ascertained and recorded. Microtome sections were prepared by embedding in paraffin, this method being found suitable even for the older, tougher portions when the harder paraffin was used.

The general structure of the stem was determined by a transverse section at 5 cm. from the tip. This showed 39 definite open collateral bundles arranged in a circle about a central cylinder of pith (FIGURE 1). These were enclosed by a stereome ring separated from the cortex by an endodermis. To determine the changes which had taken place in the development of the stem, a section was taken just above the root (FIGURE 3). Here the bundles had enlarged considerably, forming a complete woody cylinder by the growth of interfascicular cambia, and not by the interpolation of new bundles; the width had increased from 67.8 μ to 2.36 mm. The first evidence of a complete woody cylinder appeared at 88.5 cm. from the base, or at 16.5 cm. from the tip. Another change was in the broken appearance of the stereome, which at 17 cm. from the base showed 44 groups, giving evidence of the inability of these cells to stretch with the growth of the stem in circumference. Besides this a superficial periderm had formed, just above the roots, of six or seven layers in thickness. In several places where wounding had occurred it was deep enough to cut off a portion of the stereome. Very prominent, because of their brown color, were cells filled with tannin, occurring in the cortex, leptome, and pith. In the cortex the tannin filled separate cells without particular order, but in the leptome long ducts, usually three to each bundle, formed a ring concentric with the epidermis, stereome, and cambium. Besides this, single ducts appeared in the periphery of the pith at the base of the large bundles (see FIGURE 2). As the general plan of the plant has been given, the separate elements will now be considered in detail.

The pith, constituting the central cylinder of the stem, was formed of more or less spherical cells, the lignified walls of which were very delicately pitted. In the older stem the cells at the periphery contained considerable starch. The diameter of the pith averaged thirty-nine cells throughout, the increase in the size of the cells causing the enlargement in the diameter of the stem.

The hadrome elements of the bundle varied according to the age of the stem. In the younger sections the annular and spiral ducts only were lignified. In the older portions, the libriform and medullary ray cells formed by far the main percentage of the woody cylinder. The ducts were typical, comprising the annular, spiral, reticulated, and pitted. In the latter the edges of the pits were slightly thickened. They had a very large lumen averaging 71.85 μ in width with a heavy wall of 3 μ in thickness, in contrast to the spiral and ring ducts which measured 28.2 μ across their lumen, with a wall 3 μ thick also. On the innermost edge of the bundles were ducts which differed from the regular annular ring ducts in having lateral lignified circular thickenings. In some sections they appeared like distorted annular ducts, in others, the openings were decidedly lateral and showed no distortion. The long pointed libriform cells averaged to have a wall of 1.5 μ and lumen of 26.1 μ in the older parts. The walls were strongly lignified and but slightly pitted by oblique slits. The parenchyma cells surrounding the base of the bundles became lignified only in the older stem. There was little wood-prosenchyma, but what there was contained starch.

Of particular interest in the study of any Galegeae are the medullary rays in tangential section. Although these plants have no common anatomical character, still three groups have been found whose differences lay in the medullary ray construction.* In cross section in this species, they were one cell wide, had pitted walls, and were filled with starch in the older stem. In radial section they appeared rectangular in shape, forming long horizontal rows, a characteristic of the Papilionaceae and of the Caesalpiniaceae. Some rows comprised taller cells than others, which is true, too, of *Amorpha*, *Indigofera*, and *Psoralea* of the Podalyrieae.† In the younger sections the cells were found to be taller than those in the older parts. The story-like appearance of the cells in the horizontal layers was pointed out by von Höhne and verified by Saupe as occurring mostly in the Papilionaceae, also in the Caesalpiniaceae. In tangential section, the cells form long columns one cell wide, except that in some places, being two

* Saupe, Flora 70: 303. 1887.

† Saupe, *loc. cit.* 303.

cells in width and of irregular shape, they marred the otherwise "story-like" appearance.

The cambium ring separating the woody cylinder from the outer leptome mass, varied from three to seven layers according to the age of the plant (FIGURE 6). The leptome with its long sieve-tubes and companion or cambiform cells, was cut off on its outer edge. The sieve-plates were visible only after being stained with Delafield's haematoxylin or with methylene blue. Besides the ordinary transverse oblique plates, twin sieve-plates (FIGURE 7), and a number of lateral ones were found (FIGURE 5). This may be peculiar to this particular species, for no mention is made of this point in the various Leguminoseae which hitherto have been examined.

Scattered throughout the leptome portion, in the older stem, especially near the root, were single spindle-shaped cells or groups of them, more or less sclerenchymatous in character. Their outer wall was lignified, whereas their inner more or less gelatinous or mucilaginous lining consisted of cellulose.* This cellulose lining was quite separate from the wall, as the plant had been in alcohol. There was evidence, in the portion just above the root, that these fibers migrate to the outer edge of the leptome and combine to form the stereome. These cells were most abundant in the root, forming the mechanical tissue in the center in the leptome.

The stereome, formed of long thick-walled lignified cells, 1.807 mm. long, with walls 4.6 μ thick and a lumen of 6.25 μ, pectinated to form a tough fiber of considerable strength. In India, *S. aculeata* Pers. is especially cultivated for its fiber,† from which fishing nets are made. We are told that it is tough and durable, but on account of its shrinkage when wet, is not suitable for ship's cordage. In the younger portions of the stem, the stereome was thin-walled, not being lignified until one reaches a point 22.7 cm. back from the tip, or at 82.8 cm. from the base. After lignification set in, the walls began to thicken (FIGURE 8) and became more rigid. As the circumference of the stem

* Tschirch, Angewandte Pflanzenanatomie 1: 295. Chloriodide of zinc stained the lignified walls yellow, and the cellulose red-violet.

† Maiden, Some Australian vegetable fibers, Agri. Gaz. of N. S. Wales, Misc. Pub. 550: 8. 1902.

increased, the stereome, unequal to the strain, split up into masses (FIGURE 3). At a point 20 cm. from the root, it showed forty-four groups. But just above the roots were only fourteen groups, the number of cells composing each being considerably less than higher up in the stem. But added to these and serving as mechanical tissue were the scattered fibrous cells with the cellulose lining and lignified walls, or bast fibers,* which, as mentioned above, formed the transition stage between the mechanical cells of the root and stem.

Enclosing the stereome was a well-defined endodermis (FIGURE 4). In transverse section the cells were longer than they were wide. This endodermis was not constant throughout the stem. It was very definite in the younger portion, but was lacking in the old. The amount and relation of the starch to the sheath varied in the different sections. At a point 94.8 cm. from the base the starch was confined to the endodermis, where it occurred plentifully. Ten cm. lower, hardly any starch appeared. A cross section taken at 73 cm., or 11 cm. lower, showed very few starch grains scattered in the endodermis. Still lower down, or at 57 cm., the amount of starch in the endodermis was somewhat greater; while at 40.5 cm., no starch was found in the sheath, but considerable in the leptome, some in the medullary rays and some in the periphery of the pith. Still older portions showed the endodermis lacking starch. But in the leptome, in the medullary rays and in the periphery of the pith, there was a great abundance of it. Therefore the amount of starch varied according to the age of the stem. In the young or actively growing region practically none or very little starch was stored, whereas in the older portions large quantities were kept for reserve material until the time for fruiting.

According to Solereder† one often finds as characteristic of the Papilionaceae, glandular cells having a wide lumen and containing brown albuminous substance. For a long time these vessels were considered laticiferous, but the researches of Trécul‡ showed conclusively that the contents were tannin. He classifies

* Tschirch, Angewandte Pflanzenanatomie 1: 295.

† Solereder, Anatomie der Dicotyledonen 288.

‡ Trécul, Compt. Rend. 60: 225. 1865.

the principal ways that the tannin is found to occur in the plants. For *Sesban* he states that it "has tannin-like latex vessels in the external bark, under the phloem and among the pith." The species under consideration, however, had tannin in the cortex, in the leptome, and at the base of the bundles in the periphery of the pith. In the preserved condition in which this plant was studied, the cells containing this secretion appeared brown and granular and were very noticeable under the microscope. The test used for their determination was as follows: The sections were placed in concentrated aqueous solution of copper acetate for three days, and then were treated with a 20 per cent. solution of ferric acetate for a few minutes. The tannin present became greenish blue. In the cortex the tannin cells appeared without any particular order, but in the leptome long ducts had been formed which were quite regularly placed, usually three to each bundle (FIGURE 3). The cross-walls of the ducts were missing, but slight traces of their former position were observed in several places as projections from the wall into the lumen.* Researches of Avetta, Borzi, Baccarini, and Weyland show them to be syncytic in nature.† The tannin cells, themselves, were cylindrical structures, slightly constricted in the center, fitting end to end, averaging 28.16 μ long and 1.76 μ wide in the old stem.

The collenchyma forming a definite ring of three to five layers was interrupted by an aerenchyma (FIGURE 4) of more or less spongy tissue throughout the length of the stem. This was lacking in the root. In *Sesban aculata* Pers. and *Sesban marginata* Benth.,‡ however, a considerable aerenchyma was developed in place of cork in the roots, which functioned as floating tissue.

The cells forming the epidermis appeared polygonal in shape when viewed from above. The stomata were of the usual type, and were surrounded by four neighboring cells. The number of stomata varied considerably; in one strip of epidermis with an area of 7.5 sq. mm. at a point 40 cm. from the base 6, only, were found, while in a smaller piece of 4.7 sq. mm. at 14.7 cm., 22 stomata were present. No hairs of any kind were present.

* Meyen, Ueber Secretions-organe der Pflanzen, 47. Berlin, 1837.

† Solereder, Anatomie der Dicotyledonen, 294.

‡ Scott & Wagner, Floating roots of *Sesbania aculeata*. Ann. Bot. 1: 301–314. 1888. Also Schenck, Aerenchym. Jahrb. Wiss. Bot. 20: 554–557. 1889.

The structure of the root next claims our attention. The plant examined had a well-developed primary root with a thick mass of secondary ones, upon which nodules had formed. Examination of the root of a seedling showed it to be of the radial tetrarch type, the bundles enclosed by pericambial and endodermal layers. As in most Papilionaceae, there was a common meristematic zone extending across the plerome and periderm areas.* An older root showed the bundles meeting in the center, and the leptome pushed out until it formed a ring about the central woody cylinder. The bundles were formed of libriform cells and pitted ducts, but there were no ring ducts. Many of the ducts had cross-walls formed of a fan-like radiating structure† or of ladder-like construction. In this respect the root differed from the stem and from Leguminosae in general, that is, in having simple openings between ducts, as mentioned at the beginning. The medullary rays, too, showed some variation, in being from one to three cells wide. On entering the leptome area, they broadened considerably, becoming wedge-shaped. As in the stem, the cells were filled with starch. The leptome was well developed. The cells contained starch, and were interrupted in a few places by tannin ducts. Scattered in the leptome was a great number of stereome fibers, having lignified walls and a cellulose lining, being of the same kind as occurred in the stem above the root (FIGURE 9). The libriform cells, throughout the center and towards the edge of the hadrome, were of like construction. We are told that the appearance of this "3d membrane" among libriform cells is an irregular one.‡ They showed most prominently after treatment with chlor-iodide of zinc, the lignified walls becoming yellow, and the cellulose lining or "3d membrane" (Tschirch), a red-violet.

The leaf (FIGURE 10) showed the usual dorsi-ventral structure. Weyland § summed up the characteristics in his researches on the Galegeae, one of which was *Sesban.* Examination of the leaf of *S. macrocarpa* showed an agreement in all the details. The stomata appeared on both sides of the leaf, but were somewhat

* De Bary, Comparative anatomy of phanerogams and ferns, 12. [Eng. Trans.]

† "Gefächerte" prosenchyma-cells found by Saupe in species of *Sabinea* and *Sophora;* Solereder, *loc. cit.* 311.

‡ Tschirch, Angewandte Pflanzenanatomie 1: 298.

§ Weyland, Bull. Herb. Boiss. 1: appendix 3. 1893.

sunken owing to the papillose character of the epidermal cells. The neighboring cells, three or more, were arranged in no particular order. Epidermal hairs and glandular cells were lacking, the latter often being found among the Galegeae. The leaf-bundles had no sclerenchyma sheath, but lay embedded in the mesophyl. A few crystals of calcium oxalate were found in the bundles. The palisade parenchyma of two layers was rich in chlorophyl; some of the cells, however, were full of tannin. The spongy parenchyma, below, was two-layered, many cells of which also contained tannin.

The seeds of this plant were invested by an unusually hard resistant seed coat, which refused to split after the usual soaking, except for a very small percentage. Heroic measures were then resorted to. The seeds were put into boiling water and boiled for a minute or a trifle more. After this treatment every one sprouted.

Very little anatomical work has been done upon this genus. The tannin-ducts have been examined by Trécul, the leaf by Weyland, and the floating roots by Schenck and by Scott and Wagner, all of which have been referred to in the preceding pages.

In summing up, therefore, we find in *Sesban macrocarpa* the commonly recognized anatomical characters of the Leguminosae, except that some of the ducts in the roots have fan-like cross-walls in place of simple openings. As for the further characteristics of the Papilionaceae, we find that *Sesban macrocarpa* has the tannin-ducts, but wholly lacks hairs of any kind. As for the calcium oxalate secretion, it was found only in the leaf-bundles. Of special interest may be mentioned the lateral and twin sieve-plates, lateral openings in the annular ducts, the bast or stereome and the libriform fibers having the third membrane, and the resistant coat of the seeds, besides the disappearance of the endodermis in the old stem.

The study of *Sesban macrocarpa* was carried on in the Barnard Botanical Laboratory, under the direction of Professor Herbert M. Richards, to whom his student gratefully acknowledges her appreciation of his help and interest. The original material and seeds were kindly supplied by Dr. D. T. MacDougal of the Carnegie Institution of Washington, to whom the writer wishes to express her thanks. Thanks are due also to Miss Alice A. Knox for her

trouble and work in the sprouting and growing of the seedlings for examination.

BOTANICAL LABORATORY, BARNARD COLLEGE,
COLUMBIA UNIVERSITY, NEW YORK CITY.

Explanation of plate 34

FIG. 1. Transverse section of stem near tip, showing separate bundles; × 8.

FIG. 2. Detail of fig. 1. *d*, ducts; *t*, tannin; × 39.

FIG. 3. Transverse section of stem at 21 cm. from base, showing complete woody cylinder of 39 bundles; *c*, cambium; *epi*, epidermis; *lept*, leptome; *p*, pith; *st*, stereome; *t*, tannin; × 8.

FIG. 4. Transverse section of stem at 40.2 cm., showing the aerenchyma; *aer*, air space; *col*, collenchyma of 4 layers; *end*, endodermal sheath bordering *st*, stereome; *t*, tannin duct in leptome tissue; × 55.

FIG. 5. Longitudinal section of leptome with lateral sieve-plate, *l. s. p.*; *c. w.*, cell wall; × 318.

FIG. 6. Transverse section at 18 cm., showing cambium, *c*; *med*, medullary ray cells; *l. c*, libriform cells; *s. p*, sieve plates; *t*, tannin cell; *c. c*, companion cell; *c. m*, cambiform cell; × 318.

FIG. 7. Transverse section at 18 cm., showing twin sieve-plates *s, p*; *c. c*, companion cells; *c*, cambium; × 318.

FIG. 8. Transverse section at 16.7 cm., showing width of stereome walls; × 318.

FIG. Transverse section of root; *c. d*, central duct; *d*, duct; *med*, medullary ray cells; *s. f*, stereome fiber, outer wall lignified, black portion known as third membrane is of cellulose; × 318.

FIG. 10. Transverse section of leaflet near tip of the plant; *epi*, epidermis; *pal. par*, palisade tissue; *sp. par*, spongy parenchyma; *t*, tannin; *had*, hadrome; *lep*, leptome; × 318.

Additions to the flora of the Carolinas

W. C. Coker

Collections made at intervals at Chapel Hill, Orange County, North Carolina, and in Darlington County, South Carolina, have resulted in the addition of the following species to the known flora of these states:

Acer floridanum (Chapman) Pax.

This tree is not uncommon on the sandy banks and alluvial bottoms of Morgon's Creek near Chapel Hill, North Carolina. I have found it at several places here; and there are a number of medium-sized trees on the streets in the town of Chapel Hill that have been brought in from the surrounding country. In the creek bottoms the tree grows to a large size, forty feet or more high and two or more feet in diameter. The species has not been reported before from North Carolina, and the only South Carolina collection seems to be from "near Charleston" by J. H. Mellichamp 1896 (herb. N. Y. Bot. Garden). It is possible that this collection was made from a tree brought in from a distance and planted by Michaux, but supposing it to be native at Charleston, the discovery of this species at Chapel Hill extends its known range about 230 miles northward.

Acer floridanum seems to approach nearest to *Acer leucoderme* Small, but according to Dr. Small the two are quite distinct, not only in characters of foliage and fruit, but also in habit. I have not seen *A. leucoderme* in the field, but it is said to be a shrub or small tree, preferring rocky banks in the piedmont or middle districts, while *A. floridanum* is a large tree of alluvial bottoms, and confined principally to the coastal regions. That *A. leucoderme* also is present in Orange County seems certain, as it has been collected in the adjoining county of Durham to the east (herb. N. Y. Bot. Garden, from Biltmore Herb.).

Habenaria Nuttallii Small.

Collected in wet soil on the south side of Paper Mill Lake,

Hartsville, South Carolina, August, 1908. This orchid has not been collected before in the state of South Carolina, and only at Wilmington in North Carolina (herb. N. Y. Bot. Garden, *W. M. Canby*, 1867). Towards the south it has not been found nearer than Florida and southern Georgia.

SOLIDAGO VERNA M. A. Curtis.

Collected on earth dam opposite Paper Mill, Hartsville, South Carolina, May, 1909. Hitherto this very rare plant has not been found except in eastern North Carolina and no exact locality is known except near Wilmington, where it was discovered by Rev. M. A. Curtis.

In the Flora of North America, Torrey and Gray (**2**: 205. 1842), *S. verna* is given on authority of Curtis from "open sandy pine woods near Wilmington, and Lenoir County, North Carolina," to which is added "(Florida, *Herb. Rafinesque!*)." But in Gray's Synoptical Flora of North America, Lenoir County, North Carolina, and Florida are omitted from its habitat and it is given only from "open and sandy pine woods near Wilmington, N. Carolina, *Curtis.*" From this it would seem that its occurrence in Florida has not been established; but as to Lenoir County, which lies some seventy miles north of Wilmington, if Curtis said he found it there, its occurrence there can scarcely be doubted. In his 'Catalogue of the Indigenous and Naturalized Plants" of North Carolina (Geol. and Nat. History Survey of North Carolina, Part III, Raleigh, 1867) Dr. Curtis himself gives *S. verna* only from the low districts "(low dist.)."

So far as I have been able to discover, *S. verna* has been distributed only by Rev. M. A. Curtis, Dr. T. F. Wood, and Mr. Gerald McCarthy, all of whom seem to have collected their plants around Wilmington. The species is listed in Wood and McCarthy's Wilmington Flora (Journal of the Elisha Mitchell Scientific Society, **3**: 77. 1886), and in McCarthy's distribution list of "Flora of Eastern North Carolina" of 1885.

The occurrence of the plant at Hartsville, South Carolina, extends its range about one hundred and ten miles to the westward.

JUNCUS ABORTIVUS Chapman.

Four plants were collected in a damp grassy meadow in Burnt

Bay about one third of a mile behind the residence of Maj. J. L. Coker, Hartsville, South Carolina. Comparison with a sheet from Chapman's own herbarium leaves no doubt that this determination is correct. The species has heretofore been known only from western Florida near the coast. The Hartsville station extends its range over four hundred miles northward.

SCIRPUS SUBTERMINIALIS Torr.

A large quantity of this rush, hitherto supposed to be entirely northern, was found in the stream just below the "race" at Kilgore's Mill, about one mile from Hartsville. The species ranges across the northern part of the United States and Canada and has not been reported before south of New Jersey. However, on examining the sheets of this species at the New York Botanical Garden, it was found that it had been collected at Morrisonville, Mississippi, by S. M. Tracy in 1898. It is therefore probable that the species will be found to extend over the Southeastern and Gulf states.

CYPERUS MARTINDALEI Britton.

This small sedge is very common in the sand hills near Hartsville, S. C. It has not been known before except from Florida and the Gulf Coast.

CROTALARIA PURSHII DC.

Reported in Small's Flora from "Georgia and Florida to Louisiana," and it does not seem to have been reported farther to the northeast. It was collected by me at Hartsville, South Carolina, in flat sandy pine-barrens and it has been collected by House in Oconee County, South Carolina, in 1906, and by Huger in North Carolina (herb. N. Y. Bot. Garden).

VACCINIUM FUSCATUM Ait.

Given in Small's Flora from "Georgia to Florida, Arkansas, and Louisiana," and supposed to be a Florida and Gulf Coast plant. The species was collected in wet soil in "Burnt Bay," Hartsville, South Carolina, May 24, 1909. This extends its range three hundred miles northward.

GENTIANA ELLIOTTII Chapman [*Dasystephana parvifolia* (Chapm.) Small].

In the fall of 1907 a pure white form of this species was col-

lected on the side of a ditch near the Pee Dee river at Society Hill, Darlington County, South Carolina, and sent me by Mr. P. H. Rogers.* The plant was again collected by Mr. Rogers at the same place in October, 1908. The plants are said to have been rather numerous in 1907, but the ditch was worked over soon after and in 1908 there were only a few to be found. I now have four specimens of this interesting form. Albinos seem not to have been previously recorded for this species.

LIMODORUM TUBEROSUM L. (*Calopogon pulchellus* R. Br.).

Three plants of the white form were found among sphagnum on the edge of a bay on the north side of Paper Mill Lake, Hartsville, S. C., May 23, 1909, and Mr. P. H. Rogers has since collected it in the vicinity of Hartsville. This albino has been reported from Moor's Landing, New Jersey, by Dr. Britton (Bull. Torrey Club **17**: 125. 1890) and by Paine from Genesee County, New York (Cat. Pl. Oneida County, 86. 1865), but I can find no record of its occurrence in the Carolinas. The normal form is plentiful at Hartsville.

In conclusion I wish to thank Dr. John K. Small and Dr. N. L. Britton for assistance extended me in the preparation of this paper.

UNIVERSITY OF NORTH CAROLINA,
CHAPEL HILL, N. C.

* It is interesting to note that Society Hill was for several years the home of the gifted botanist, Rev. M. A. Curtis.

New North American Crataegi

W. W. Eggleston

Crataegus Tracyi Ashe in herb. N. Y. Bot. Gard.

Leaves obovate to ovate, 2.5–4.5 cm. long, 1.5–3.5 cm. wide, obtuse or acute at the apex, cuneate at the base, finely serrate, sometimes with a pair of irregular obtuse lobes towards the apex, occasionally lobed on one side only, membranaceous, bright, appressed-pubescent above, tomentose along the veins and paler below; petioles about 1 cm. long, slightly winged above, and somewhat tomentose; corymbs many-flowered, corymbs and calyx slightly villose, flowers about 15 mm. broad, calyx-lobes lanceolate-acuminate, glandular-laciniate, often irregularly so; stamens about 10; styles 3 or 4, with tuft of tomentum at base; immature fruit ellipsoidal, pubescent, about 7 mm. thick; calyx-lobes appressed; nutlets usually 3, about 6 mm. long, nest of nutlets about 6 mm. thick, ridged on the back. Round-topped trees 5–6 m. high; young twigs tomentose, soon becoming glabrous, armed with numerous straight, slender, chestnut-brown spines 3–6 cm. long.

Closely allied to *C. Greggiana* Eggl. of Mexico.

Type, *Tracy & Earle 172*, foothills of Davis Mts., Texas, Apr. 23, 1902. (Herb. N. Y. Bot. Gard.)

A part of the description was drawn from the following specimen:

Mexican Boundary Survey *351*, Rio Limpio, Texas, July 20, *Bigelow*. (Herb. N. Y. Bot. Gard.)

I would also refer to this species:

W. L. Bray 176, Turtle Creek, Kerr Co., Texas, May 1, 1899. (Herb. U. S. Nat. Mus.)

The station of Bigelow's on Limpio Creek and that of *Tracy & Earle* near the head of Toyah Creek are within a few miles of each other and but a short distance from Fort Davis.

Professor Tracy says in regard to his station: "*C. Tracyi* Ashe, was from the foothills on the north side of Davis Mts. We camped for a late dinner at the head of Toyah Creek, south of

Phantom Lake and Sargossa at Toyahvale P. O. It is my recollection that we went about five miles south before we struck the hills, but, whatever the distance, the *Crataegus* was found quite abundantly at the southeast foot of the first hill we reached, a round-topped hill on the west of the road just where the road makes a sharp turn from south to east.

"South of the hill is a level meadow, a part of which is in cultivation, while to the north and west the country is almost barren desert, and east of this hill is a still higher hill which is the beginning of a long range of high hills. The specimens were taken about a hundred yards west from the road, where it runs through a fenced lane in a depression between the hills."

Crataegus Brittonii sp. nov.

C. Vailiae Beadle in Small, Fl. Southeast. U. S. 561. 1903. Eggleston, in Gray's Manual ed. 7, 467. 1908. Not *C. Vailiae* Britton, Bull. Torrey Club **24**: 53. 1897.

Leaves ovate or broadly ovate, 2–4 cm. long, 1.5–3.5 cm. wide, acute or obtuse at the apex, cuneate, sometimes abruptly so, at the base, crenate or crenate-serrate with two or three pairs of shallow crenate lobes, membranaceous, rather dark green and shining, somewhat impressed-veined and slightly appressed-pubescent becoming glabrous above, paler and tomentose along the veins below; petioles 5–10 mm. long, rough-tomentose; corymbs 1–6-flowered, flowers about 15 mm. wide, pedicels and calyx-tube tomentose; calyx-lobes glabrous below, sometimes slightly pubescent above, ovate, obtuse, laciniate, three or four of the apical teeth often equal; stamens about 20, anthers white; styles 5, tomentose about the base; fruit globose or short-pyriform, 8–12 mm. thick, reddish-brown, slightly pubescent, falling about September 15th; calyx prominent, calyx-lobes reflexed, persistent; flesh firm; nutlets 5, 5–6 mm. long, grooved on the back, with a calyx-scar, nest of nutlets 7–8 mm. thick. Vegetative twigs light brown, slightly tomentose becoming glabrous, armed with numerous straight, slender thorns 2–5 cm. long. Tall ascending branched shrubs, sometimes 3 or 4 m. high.

Type, *Eggleston 4134*, Biltmore, North Carolina, Sept. 15–19, 1908, altitude 660 m. (Herb. N. Y. Bot. Gard.)

Other specimens used in description:

Biltmore Herb. *5881*^{b}, Biltmore, North Carolina, May 21 and Sept. 18, 1898. Biltmore Herb., May 15 and Sept. 17, 1902.

Eggleston 4162, along French Broad River, Paint Rock, North Carolina, alt. 450 m., Sept. 22, 1908.

Thomas H. Kearney, Jr. 696. Along the French Broad River, near Wolf Creek Station, Cocke County, Tennessee, Aug. 24, 1897.

A. Ruth 286 (in part), Wolf Creek, East Tennessee, July 18, 1898.

John K. Small, Canyon at Tallulah Falls, Rabun Co., Northern Georgia, 480 m., Aug. 4, 1893.

Eggleston, N. Y. Bot. Garden Fruticetum *17496*, Oct. 1906.

C. Vailiae Britton, known only on the Roanoke River, at Roanoke, Va., and the James River at Clifton Forge, Va., is one of the *Macracanthae* Loudon; while *C. Brittonii* belongs to the group *Parvifoliae* Loudon.

C. Brittoni differs from *C. tomentosa* L. (*C. uniflora* Muench.) by much higher and more regular habit; globose, smaller, brown, and early ripening fruit; larger corymbs; less tomentose, short and blunt calyx-lobes; less tomentose, crenate-lobed leaves; and slightly tomentose twigs.

Crataegus Williamsii sp. nov.

Leaves ovate, 2–9 cm. long, 1.5 to 6 cm. wide, acute or acuminate at the apex, cuneate, often sharply so, at the base, serrate with fine gland-tipped teeth excepting towards the base, cut towards the apex with 2–4 pairs of ascending, shallow acute lobes, membranaceous, slightly appressed-pubescent above, glabrous below excepting along the midrib and junctions of the veins, which are often slightly tomentose; petioles 1–3 cm. long, slightly winged above, somewhat pubescent; corymbs many-flowered, pilose, flowers 14–18 mm. wide; calyx and lobes nearly glabrous outside, calyx-lobes pubescent inside, ovate, acuminate, with occasional stalked glands; stamens about 10; styles usually 3 or 4; fruit globose, 8–10 mm. thick, red, slightly pubescent, calyx-lobes reflexed, persistent; nutlets 3 or 4, strongly ridged on the back, 5–7 mm. long, nest of nutlets 5–6 mm. thick. Twigs glabrous, armed with sharp thorns 3–6 cm. long. Round-topped shrubs, sometimes 4 m. high, belonging to the group *Rotundifoliae* Eggl.

Type, *R. S. Williams*, Columbia Falls, Montana, Sept. 14, 1892. (Herb. N. Y. Bot. Gard.)

Other specimens used in description:

R. S. Williams, Columbia Falls, Montana, May 19, 1897.

D. T. MacDougal 475, Flathead Plains, northwestern Montana, June 29, 1901, alt. 1000 m.

L. M. Umbach 253, ravines, Polson, Montana, Aug. 19, 1901.

B. T. Butler 500, *501*, *503*, *504*, and *507*, Big Fork, northeastern border of Flathead Lake, Montana, Aug. 23, 1908.

B. T. Butler 512, Yellow Bay, Flathead Lake, Montana, Aug. 8, 1908.

B. T. Butler 525 and *526*, Ravalli, Montana, Aug. 26, 1908.

B. T. Butler 521–523, southwest border of Flathead Lake, Aug. 19, 1908, represents a form with leaves two cm. wider than the type.

This species occurs with *C. Douglasii* Lindl. and in leaf might easily be mistaken for it, having the appressed pubescence of the upper surface and the nearly glabrous lower surface, like *C. Douglasii;* but *C. Williamsii* has red fruit with unpitted nutlets, while *C. Douglasii* is black fruited with pitted nutlets. It is much nearer *C. columbiana* Howell but has larger, less pubescent leaves, with their apexes and lobes less acuminate, while the fruit is larger and matures at least two weeks later than *C. columbiana* fruit.

This species seems to be local in the Flathead River basin, and the nearest station from which I have seen *C. columbiana* is at Dixon, Montana, near the mouth of the Flathead River.

NEW YORK BOTANICAL GARDEN.

New combinations in Araliaceae

RICHARD C. SCHNEIDER

ACTINOPHYLLUM [Ruiz & Pavon] * Pavon †

Sciodaphyllum P. Browne, Nat. Hist. Jam. 190. *pl. 19. f. 1, 2.* 1756.

P. Browne's genus *Sciodaphyllum* (*Sciadophyllum* Rchb.), one of the several instances in which he neither described nor cited a binomial species, was renamed *Actinophyllum* by Ruiz and Pavon.* They also failed to describe or cite a binomial species; therefore, as *Actinophyllum* was the first to receive such species, described by Pavon in 1797, *Sciodaphyllum* not receiving species until 1804, *Actinophyllum*, according to the provisions of the "American Code," must be retained.

The following are the known West Indian species, which may be keyed thus:

Umbels panicled.	1. *A. Belangeri.*
Umbels racemed.	
Leaflets glabrous above and below.	2. *A. Sciadophyllum.*
Leaflets glabrous above, pulveraceous below.	3. *A. troyanum.*

1. **Actinophyllum Belangeri** (E. March.) R. C. Schneider

Sciadophyllum Belangeri E. March. Bull. Acad. Roy. Soc. Belg. II. **47**: 92. 1879.

On the Island of Martinique, *Bélanger.*

2. **Actinophyllum Sciadophyllum** (Sw.) R. C. Schneider

Aralia Sciodaphyllum [*Sciadophyllum*] Sw. Prod. Veg. Ind. Occid. 55. 1788.

Occurring on the mountains of the Island of Jamaica, W. I., as a large shrub or small tree, at an altitude of 700 to 1,000 m., attaining a height of about 7 meters.

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* Prod 51. *pl. 8.* 1794.

† Mem. Acad. Mad. 1: 194. 1797.

3. **Actinophyllum troyanum** (Urb.) R. C. Schneider

Sciadophyllum troyanum Urb. Symb. Ant. **5**: 451. 1908.

On the Island of Jamaica as a tree about 5 m. high, at an altitude of 660 meters, near Troy, collected by Harris, *no. 9369*, (type). (Co-type in herb. N. Y. Bot. Gard.)

DENDROPANAX Decaisne & Planchon, Rev. Hort. IV. **3**: 107. 1854

Gilibertia Ruiz & Pavon, Prod. 50. *pl. 8.* 1794 (without species); Fl. Per. et Chil. **3**: 75. *pl. 312.* 1802. Not *Gilibertia* J. F. Gmelin, 1791.

Dendropanax brachypodum (Urb.) R. C. Schneider

Gilibertia brachypoda Urb. Symb. Ant. **5**: 452. 1908.

Dendropanax insulare (Rose) R. C. Schneider

Gilibertia insularis Rose, U. S. Dept. Agric. N. Am. Faun. 14: 83. 1899.

Dendropanax laurifolium (E. March.) R. C. Schneider

Gilibertia laurifolia E. March.; Urb. Symb. Ant. **1**: 203. 1899.

?*Dendropanax laurifolium* Decaisne & Planchon, Rev. Hort. IV. **3**: 107. 1854. (Nomen nudum.)

NEW YORK BOTANICAL GARDEN.

A new Hawaiian Scaevola

JOSEPH F. ROCK

Scaevola Swezeyana Rock

A shrub 9–12 dm. high, with stiff, glabrous, rambling branches. Leaves glabrous, oblanceolate, 38–76 mm. × 12–18 mm., on

Scaevola Swezeyana Rock. About one half the natural size.

petioles 6–13 mm. long, mucronate, entire, somewhat fleshy; peduncle single-flowered, 4–6 mm. long, entire, slightly pubescent, with two oblanceolate, foliaceous bracts below the calyx 6–18 mm. long by 2 mm. broad; calyx 4 mm., glabrous, with short, bluntish teeth of unequal size; corolla pubescent, 5-lobed, yellowish green with reddish brown streaks; tube 18 mm. long, erect, corolla-lobes linear-lanceolate, sharp-pointed, scarcely margined, 16 mm. × 3 mm.; stamens somewhat longer than the tube; style incurved, pubescent throughout, little shorter than the corolla, indusium glabrous, ciliate; drupe glabrous, crowned by the calyx-teeth, 5–6 mm., two-celled, putamen black, crustaceous.

The type is *no. 4804* (in the herbarium of the Board of Agriculture and Forestry), collected in the woods on the middle ridge of Niu Valley, Oahu, at an elevation of 1200 feet (August 22, 1909). The species is named in honor of Mr. O. H. Swezey of the Hawaiian Sugar Planters' Experiment Station, who discovered the plant and called my attention to it.

HAWAIIAN BOARD OF AGRICULTURE,
HONOLULU, HAWAII.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1909)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

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